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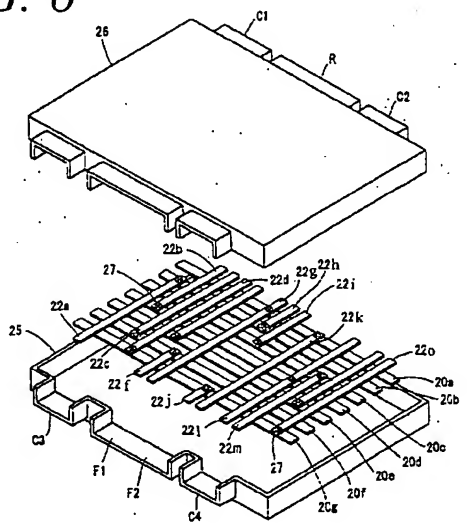
## (54) Electrical connector housing

(57) The circuitry contained in an electrical connector housing is standardized, so that its manufacturing, modification and addition can be simplified. To this end, a circuitry is designed so as to comprise a plurality of unit circuits, both ends of which are to be connected to an electrical part such as a relay (R), fuse (F1 and F2) or connector (C1, C2, C3 and C4). These unit circuits are made of the same electrically conductive material (20a to 20g) and formed into a long and narrow element. The unit circuits are arranged in parallel at a given pitch to one another. The electrically conductive element (20a to 20g) of each unit circuit is connected to the electrical part through another electrically conductive element (22a to 22o) arranged substantially perpendicular thereto.

*FIG. 6*

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## Description

**[0001]** The present invention relates to electrical connector housings used for example in automobiles. More particularly, the electrical connector housing according to the invention is used as a junction box that contains a plurality of branch circuits and on which can be mounted electrical relays, fuses and electrical connectors. In the inventive electrical connector housing, the circuit configuration can be standardized for making it easier to form the circuitry and respond to changes.

**[0002]** The automobile industry is continually searching for the most efficient way of reducing the costs of manufacturing wire harnesses used in automobiles. In this connection, it is very important to optimize the structural and wiring design of an electrical connector housing. This applies to internal circuits and connector receptacles for receiving external terminals as well as to a corresponding connector assembly including external terminals that fit into the connector receptacles.

**[0003]** Automobiles are packed with different kinds of electrical parts or electrical apparatuses, depending on their grade, type or model. Usually, the higher is their grade, the greater is the number of circuits used. In order to respond to the variations in this number of circuits as a function of the vehicle grades, it is preferable to standardize the structure of electrical connector housings, the bus bars they contain, and the connector assemblies received by the connector receptacles of electrical connector housings. In this way, these elements can be used for all automobile grades and thus gain a wider use. By contrast, the number of external terminals to be contained in a connector assembly is determined by the automobile's grade, so that one connector assembly contains only the number of external terminals necessary for a particular grade. For instance, for two different car grades of the same model, the electrical connector housing, its bus bars and the connector assembly may be structurally standardized, the only difference being that circuits for high comfort apparatuses are not provided for in the connector assembly of low grade cars. In this context, the low-grade connector assembly is not provided with a sufficient number of outer terminals to connect with all the available bus bars contained in an electrical connector housing.

**[0004]** FIG. 1 shows an electrical connector housing commonly used in automobiles. Such an electrical connector housing is in the form of a case consisting of a lower case 1 and an upper case 2. The case contains bus bars 3 and insulating plates 4 stacked in alternation. The bus bar 3 is made by stamping out a given form of circuitry from an electrically conductive plate, and comprises a series of projecting tabs. Relays, fuses or connectors are mounted in fitting units formed on the lower case 1 and/or the upper case 2. The tabs 3a are then connected to electrical relays, fuses or connectors via transit terminals (not shown in the figures).

**[0005]** In some cases, coated conductive wires are used instead of bus bars 3. Cramping members are then press-fitted to the coated conductive wires, and the latter are thus connected to relays, fuses or connectors via transit terminals.

**[0006]** When bus bars are used, their design has to be changed each time the routings need to be modified. The circuitry modification calls for a change of the molds used for bus bar manufacturing and thus incurs high costs. It is also difficult to respond quickly to circuit modifications or additions. Alternatively, when coated conductive cables or wires and cramping members are used, the coated conductive cables have to be wired along a given routing. To this end, guiding means have to be provided on insulating plates or on the inner surface of the case. Accordingly, when a circuit is modified or added, the insulating plates and the case, as well as the molds for making them, have to be changed. The consequent need to make a new mold also incurs a cost, just as in the case of bus bars.

**[0007]** To counter these problems, standardized circuit elements have been developed, in which modifications or additions may easily be made (FIGS. 2 and 3).

**[0008]** FIG. 2 (A), (B), (C) and (D) show branch connection boxes designed by the present inventors and published as Japanese Utility Model HEI-5-55718. The branch connection boxes have two cases 6 and 6 of the same configuration, each including the same number of connector receptacles 5a and corresponding rear portions opposite them. The cases 6 contain a plurality of bus bars 7 each one having the same bifurcate fork-shape and being symmetrical about its longitudinal center axis. The two cases 6 and 6 are then stacked back to back so that the connector receptacles 5a face in opposite directions. The bus bars 7 are then mounted into the cases 6 and 6 such as to be aligned parallel to one another. Subsequently, electrical cables 8 are cramped into the center portion of bifurcate fork shape bus bars 7, so that the bus bars 7 and the electrical cables 8 are electrically connected.

**[0009]** FIG. 3 shows an electrical connection box disclosed in US Patent 5057026. In this box, bus bars 9 have a fixed narrow width, and are arranged in parallel. The bus bars 9 are provided at given positions with tabs 9a including cramping blades. Electrical cables 10 are aligned in a direction perpendicular to the bus bars 9 and connected thereto by pushing down the cramping blades. Bus bars 9 and electrical cables 10 thus form a planar circuit stackable on an insulating plate 11, and a plurality of such units are formed into a layered structure. A connector assembly 12 is arranged nearby alongside the layered structure. The layers of bus bars 9 are then connected to one another through the connector assembly 12.

**[0010]** In the branch connection box shown in FIG. 2, a connector assembly is fitted into a corresponding connector receptacle 5a. When the connector assembly is not provided with a sufficient number of outside terminals, as is the case of low-grade connector assemblies,

a considerable number of bus bars 7 may be left unconnected to any outside terminal and thus not used as circuits. Further, the space for containing connectors is limited, so that, when the number of circuits is increased, the width of the case must be broadened. It then becomes more difficult to produce higher density circuitry.

**[0011]** In the electrical connection box shown in FIG. 3, the lengths of bus bars 9 are determined beforehand, and the bus bars are aligned in parallel at given positions. The bus bars 9 are then connected to electrical cables by cramping to form circuits. This process requires several process steps and many connection sites, making production complex. Besides, as a connector assembly 12 is needed for connecting the layers of bus bars 9, specific parts have to be prepared. Such complicated process steps and the provision of specific parts incur a high production cost.

**[0012]** The present invention has been devised to solve the above-mentioned problems. According to the electrical connector housing of the invention, electrically conductive elements for forming all circuits may be made of the same material, so making it simpler and cheaper to produce circuit materials. Furthermore, it is easy to modify or add circuits, assembly work is simplified, and the number of parts is reduced.

**[0013]** To this end, there is provided an electrical connector housing comprising a plurality of unit circuits. The plurality of unit circuits are comprised of first electrically conductive elements made of the same material and formed into the shape of a long strip with narrow width. The first electrically conductive elements are arranged in parallel at a given interval, and connected respectively to an electrical part, such as an electrical relay, fuse or connector, through second electrically conductive elements. The second electrically conductive elements are arranged in a direction substantially perpendicular to the length direction of the first electrically conductive elements, thereby forming intersection faces including contact points between the first and the second electrically conductive elements.

**[0014]** Preferably, the first electrically conductive elements and the second electrically conductive elements are made of the same material. Further, the first electrically conductive elements have the same length, whereas the second electrically conductive elements have a length varying as a function of the distance between the electrical part and the unit circuit, and the second electrically conductive elements are each used after having been cut out into a given length.

**[0015]** Typically, at least the first electrically conductive elements or the second electrically conductive elements have an insulating film adhered or coated thereon on at least the intersection face including the contact points, and the insulating film is stripped off at the contact points so as to form electrical contact points between the first and the second electrically conductive elements. Thereafter, the electrical contact points are bonded.

**[0016]** There is also provided an electrical connector housing, wherein the plurality of unit circuits are stacked in layers, and the electrical part such as an electrical relay, fuse or connector is mounted sideways onto each of the layers comprising the plurality of unit circuits, such that the second electrically conductive elements cross the first electrically conductive elements at substantially right angles, and are connected thereto.

**[0017]** The first and the second electrically conductive elements may be comprised of bus bars.

**[0018]** When the electrically conductive elements are already adhered or coated with an insulating film, the coating process as described above for bus bars may not be required.

**[0019]** Accordingly, the first electrically conductive elements or the second electrically conductive elements adhered or coated with an insulating film on at least the intersection faces including the contact points, may be comprised of electrical wires, or a flexible printed circuit whose electrically conductive elements comprise copper foils or bare conductive wires.

**[0020]** A unit circuit is defined as an electrically conductive element, a terminal of which is connected to a relay, fuse or connector. There is therefore no need to connect these unit circuits to one another. Accordingly, the connector assembly 12 for connecting bus bars 9 therebetween, shown in FIG. 3, is no longer needed. When a circuit is to be altered or supplemented, the corresponding first electrically conductive element, arranged in parallel to other elements, may be removed or added. Thereafter, a newly arranged circuit may be prepared and connected to a given relay, fuse or connector through a perpendicularly-arranged second electrically conductive element. Circuit alterations or additions can thus easily be made.

**[0021]** The first electrically conductive elements used for unit circuits have the same length and are arranged in parallel. The first electrically conductive elements are connected to electrical parts such as electrical relays, fuses or connectors through perpendicularly-arranged second electrically conductive elements. The length of each of second electrically conductive element varies depending on the distance between the unit circuit and an electrical part to which it is to be connected. Preferably, the first electrically conductive elements used for unit circuits and the second electrically conductive elements used for connecting to electrical parts are made of the same material.

**[0022]** Preferably yet, the second electrically conductive elements are applied after they have been prepared by cutting off the material at a given length.

**[0023]** As mentioned above, the first electrically conductive elements disposed in parallel as unit circuits, and the second electrically conductive elements for connecting to electrical parts arranged perpendicular thereto, are made of the same material. Furthermore, the first electrically conductive elements can be made into the same length by simply cutting off the same material at

a fixed specific length. Likewise, the second electrically conductive elements can be prepared by simply cutting off different lengths of the same material. Accordingly, circuit elements can be prepared very easily at low cost.

**[0024]** The first electrically conductive elements used for unit circuits, and the second electrically conductive elements for connecting to electrical parts such as relays, fuses or connectors, may be formed for instance by bus bars or electrical wires or cables, as well as by flexible printed circuits (FPCs), whose conductive portions consist of copper foils or bare conductive wires or cables.

**[0025]** When, typically, bus bars are used as a first and a second electrically conductive element and intersected with each other, at least one of those bus bars is covered with an insulating coating at their intersection face. Subsequently, the bus bars are stripped of insulating coatings at their contact sites, and are bonded by resistance, ultrasonic or laser welding, soldering or by direct binding means such as riveting. They are thus connected to each other.

**[0026]** Alternatively, the first electrically conductive elements used for unit circuits and the second electrically conductive elements for connecting to electrical parts may be electrical wires or cables. When making connection on the intersection faces, both electrical wires may be connected by using cramping members serving as electrical terminals. When an FPC is used, insulating coatings are stripped off at the contact points, so that copper foils or the conductive wire core are exposed for subsequent welding.

**[0027]** Upon being arranged in parallel, the above unit circuits may be stacked vertically so as to form layers. Electrical parts such as relays, fuses and connectors, which are to be mounted sideways into the electrical connector housing, may then be connected to the first electrically conductive elements of the unit circuits. The latter are assembled on each layer, such that second electrically conductive elements for connecting to electrical parts cross the first electrically conductive elements substantially at right angles.

**[0028]** The above and the other objects, features and advantages of the present invention will be made apparent from the following description of the preferred embodiments, given as non-limiting examples, with references to the accompanying drawings, in which:

FIG. 1 is an exploded perspective view of a prior art electrical connector housing;

FIGS. 2 A to D are exploded views of a second prior art electrical connector housing;

FIG. 3 is an exploded perspective view of a third prior art electrical connector housing;

FIG. 4 is a view of an example of commonly known circuitry contained in an electrical connector housing;

FIG. 5 shows a connection design of circuitry contained in an electrical connector housing according to the present invention;

FIG. 6 is an exploded perspective view of an electrical connector housing containing circuitry corresponding to FIG. 5;

FIG. 7 is a schematic cross-sectional view of the contact points, when the first electrically conductive elements used for unit circuits are connected to the second electrically conductive elements for connecting to electrical parts;

FIG. 8 is a schematic cross-sectional view of a second embodiment of the invention, in which unit circuits are stacked in layers;

FIG. 9 shows a third embodiment of the present invention in which electrical wires are used, where (A) is a schematic perspective view of an entire circuit, and (B) shows a cross-fix configuration when electrical wires are connected by means of a cramping member; and

FIG. 10 shows a fourth embodiment of the present invention in which an FPC is used, where (A) is a schematic perspective view of an entire circuit, and (B) is an enlarged cross-sectional view of a contact point between the first and the second electrically conductive elements.

**[0029]** FIG. 4 is a view of typical circuitry included in a known electrical connector housing. In FIG. 4, C1 and C2 indicate connectors mounted in a connector receptacle provided at a first side (X side) of the case consisting of a lower case and an upper case, while C3 and C4 represent connectors mounted in a connector receptacle provided at a second side (Y side) of the case. Likewise, R represents a relay mounted in a relay receptacle provided at the X side of the case, while F1 and F2 represent fuses mounted in a fuse receptacle provided at the Y side of the case.

**[0030]** In the circuitry of FIG. 4, the unit circuits may be defined as the circuits having one end connected to a first relay, fuse or connector, respectively, and the other end connected to a second relay, fuse or connector. For example, circuit a has one end connected to a relay R, and the other end that is divided into two branches, one of which is routed to fuse F1 and the other to fuse F2. Circuit b has one end connected to connector C3 and the other end connected to relay R. Circuit c has one end connected to connector C4 and the other end connected to relay R. Circuit d has one end connected to connector C4 and the other end connected to connector C2. Likewise, in circuits e, f and g, both ends are connected to either a connector, a relay or a fuse.

**[0031]** The above-mentioned typical circuitry can be implemented by means of the present invention as shown in FIGS. 5 and 6 in the following manner. Unit circuits a to g are comprised of first electrically conductive elements, e.g., bus bars 20a to 20g, each of which has the same length with a narrow width. The bus bars 20a to 20g are arranged in parallel at a given pitch, and are contained in an electrical connector housing con-

sisting of a lower case 25 and an upper case 26. The lengths of bus bars 20a to 20g aligned in parallel are disposed substantially perpendicular to the direction in which a connector, relay or fuse is mounted.

**[0032]** The second electrically conductive elements for connecting to electrical parts such as connectors, relays and fuses, may be made of the same bus bar material as the one used for bus bars 20a to 20g serving as unit circuits. This material is then cut off at a required length to yield bus bars 22a to 22o.

**[0033]** In FIG. 6, most of bus bars 22a to 22o are connected to a respective unit circuit at one end. In some cases, in order to raise wiring efficiency, bus bars may be connected to a unit circuit at a middle portion of their length, as in the case of bus bars 22g and 22l.

**[0034]** The upper face of each of bus bars 20a to 20g may be adhered or coated with an insulating film 21. The insulating film 21 is then locally cut away at the sites where bus bars 20a to 20g intersect with bus bars 22a to 22o; at these interconnections, bus bars 20a to 20g are led to a connector, relay or fuse. In such a case, bus bars 22a to 22o may not be adhered nor coated with any insulating film.

**[0035]** Alternatively, bus bars 22a to 22o - instead of bus bars 20a to 20g - may be adhered or coated with an insulating film. Their connecting sites with bus bars 20a to 20g may then be stripped of the insulating film. In such a case, the bus bars 20a to 20g for unit circuits may not be adhered nor coated with any insulating film.

**[0036]** When, for instance, bus bars 20a to 20g for unit circuits are adhered or coated with an insulating film 21, bus bars 22a to 22o for connecting to electrical parts are arranged to cross over bus bars 20a to 20g substantially at a right angle, with the insulating film 21 interposed therebetween. Although the length of each of bus bars 22a to 22o may be different, they are aligned parallel to one another. The insulating film 21 is then removed from each of bus bars 20a to 20g at their intersection face with bus bars 22a to 22o. An end portion of each of bus bars 22a to 22o (except for some bus bars such as 22g or 22l shown in FIG. 6 as an example) is then put into contact with the corresponding exposed face portion of bus bars 20a to 20g. As for the bus bars 22g and 22l, their middle portions are connected with bus bars 20a and 20d in the same manner, respectively. As shown in FIG. 7, both portions are then bonded by resistance welding 27 and connected together. Bus bars 22g and 22l are set to be long enough to span across bus bars 20a to 20g and their middle portion is resistance-welded to the insulating film-free portion of bus bars 20a and 20d, respectively. The technique for connecting bus bars 20a to 20g to bus bars 22a to 22o is not limited to the above-mentioned resistance welding, but also includes ultrasonic welding, laser welding, soldering or riveting etc.

**[0037]** The other end portion of each of bus bars 22a to 22o is connected either to connector C1, C2, C3 or C4, or to relay R, or to fuse F1 or F2.

**[0038]** FIG. 8 shows a second embodiment of the present invention. As shown in this figure, when the number of unit circuit bus bars to be loaded on a unit layer increases, the bus bars may be divided and loaded onto different layers, the layers being subsequently superposed on one another. In this case, insulating plates 28 are interposed between different layers. When both of bus bars 20a to 20g used as unit circuits and bus bars 22a to 22o used for connecting to electrical parts are coated with insulating films, the interposition of insulating plates 28 may not be required.

**[0039]** FIGS. 9A and 9B show a third embodiment in which first electrically conductive elements used as unit circuits, and second electrically conductive elements used for connecting to electrical parts, are both comprised of coated conductive wires connected by means of cramping members 30. The cramping members 30 each have an L-shaped horizontal cross-section (viewed from the top, as depicted in FIG. 9B). They may have a different length of cross-section and include at their bottom portion slots 30b provided with cramping blades 30a. The cramping blades 30a connect the first coated conductive wires w1 (used as unit circuits) to the second coated conductive wires w2 (used for connecting to electrical parts) by applying a downward pressing force.

**[0040]** FIGS. 10A and 10B show a fourth embodiment, in which an FPC 43 serves to form the first electrically conductive elements used as unit circuits, and the second electrically conductive elements used for connecting to electrical parts. The FPC 43 is prepared by arranging copper foils or bare conductive wires in parallel to form electrically conductive elements 40, and by coating both faces thereof with insulating films 41 and 42. When used as unit circuits, the electrically conductive elements 40 having the same length are formed as an FPC 43, and the corresponding FPC 43 is cut out in rectangular shapes. Further, the insulating films are cut away at the connection sites. When used for connecting to electrical parts, the FPC 43 is cut off so that each of electrically conductive elements 40 has the desired length. When the FPC 43 is used, the first and the second electrically conductive elements 40 are bonded by resistance welding or the like, and are thus connected to each other.

**[0041]** Although not shown in figures, when an electrical connector housing contains several layers, the latter may comprise different types of circuitry, depending on the intensity of the electric current flowing in the circuitry. For instance, the housing may contain a first layer wired with bus bars, a second layer wired with electrical wires or cables, and a third layer wired with FPC. Further, the electrically conductive elements used as unit circuits, and those used for connecting to electrical parts, may not necessarily be made of the same material. For example, the first electrically conductive elements used as unit circuits may be formed from an FPC, whereas the second electrically conductive elements

used for connecting to electrical parts may be electrical wires or cables. The end portion of electrical wires or cables may then be stripped of insulating films, and the conductive portion thus exposed may be welded to the conductive portion of the FPC.

**[0042]** According to the invention, unit circuits are prepared by initially arranging fixed lengths of first electrically conductive elements in parallel. When electrical parts such as connectors, relays and fuses are to be connected, second electrically conductive elements may simply be set up transversally to the first electrically conductive elements substantially at a right angle. By virtue of this configuration, the circuitry is simplified, and the number of connection sites can be reduced.

**[0043]** When a circuit is to be modified or supplemented, an electrically conductive element as unit circuit may simply be removed or added, and the modified or added element can easily be connected to an electrical part through a second electrically conductive element. Electrically conductive elements can thus be modified or added simply. Moreover, circuit addition does not require a large space. Therefore, the electrical connector housing of the invention can be kept reasonably small.

**[0044]** Although the electrical connector housing may have a multi-layered structure, connections between layers are not necessary, so that the number of parts can be reduced. Further, electrically conductive elements used as unit circuits and those used for connecting to electrical parts can be made of the same material. Accordingly, these elements can be prepared by simply cutting this material into given lengths of element. They can thus be produced easily and at a low cost. The cost reduction obtained by virtue of this manufacturing method is very large.

## Claims

**1.** An electrical connector housing comprising a plurality of unit circuits, characterised in that said electrical connector housing is comprised of first electrically conductive elements (20a to 20g) made of a same material and being formed into the shape of a long strip with a narrow width, said first electrically conductive elements (20a to 20g) being arranged in parallel at a given interval, and connected respectively to an electrical part such as an electrical relay (R), fuse (F1 and F2) or connector (C1, C2, C3 and C4) through second electrically conductive elements (22a to 22o), said second electrically conductive elements (22a to 22o) being arranged in a direction substantially perpendicular to the length direction of said first electrically conductive elements (20a to 20g), thereby forming intersection faces including contact points between said first (20a to 20g) and said second electrically conductive elements (22a to 22o).

**2.** The electrical connector housing according to claim 1, wherein said first electrically conductive elements (20a to 20g) and said second electrically conductive elements (22a to 22o) are made of the same material, wherein said first electrically conductive elements 20a to 20g) have the same length, whereas said second electrically conductive elements (22a to 22o) have a length varying as a function of the distance between said electrical part and said unit circuit, and wherein said second electrically conductive elements (22a to 22o) are each used after having been cut out into a given length.

**3.** The electrical connector housing according to claim 1 or 2, wherein at least said first electrically conductive elements (20a to 20g) or said second electrically conductive elements (22a to 22o) are adhered or coated with an insulating film (21) on at least said intersection faces including said contact points, said insulating film (21) is stripped off at said contact points so as to form electrical contact points between said first (20a to 20g) and said second electrically conductive elements (22a to 22o), and wherein said electrical contact points are bonded.

**4.** The electrical connector housing according to claim 1 or 2, wherein said plurality of unit circuits are stacked in layers, and said electrical part such as an electrical relay (R), fuse (F1 and F2) or connector (C1, C2, C3 and C4) is mounted sideways onto each of said layers comprising said plurality of unit circuits, such that said second electrically conductive elements (22a to 22o) cross said first electrically conductive elements (20a to 20g) substantially at right angles, and are connected thereto.

**5.** The electrical connector housing according to claim 3, wherein said plurality of unit circuits are stacked in layers, and said electrical part such as an electrical relay (R), fuse (F1 and F2) or connector (C1, C2, C3 and C4) is mounted sideways onto each of said layers comprising said plurality of unit circuits, such that said second electrically conductive elements (22a to 22o) cross said first electrically conductive elements (20a to 20g) substantially at right angles, and are connected thereto.

**5.** The electrical connector housing according to any one of claims 1 to 4, wherein said first (20a to 20g) and said second electrically conductive elements (22a to 22o) are comprised of bus bars.

**6.** The electrical connector housing according to claim 3, wherein said first electrically conductive elements (20a to 20g) or said second electrically conductive elements (22a to 22o) adhered or coated with an insulating film (21) on at least said intersection faces including said contact points, are com-

prised of electrical wires (W1 and W2), or a flexible printed circuit (43) whose electrically conductive elements (40) comprise copper foils or bare conductive wires.

**7.** The electrical connector housing according to claim 5, wherein said first electrically conductive elements (20a to 20g) or said second electrically conductive elements (22a to 22o) adhered or coated with an insulating film (21) on at least said intersection faces including said contact points, are comprised of electrical wires (W1 and W2), or a flexible printed circuit (43) whose electrically conductive elements (40) comprise copper foils or bare conductive wires.

*FIG. 1*

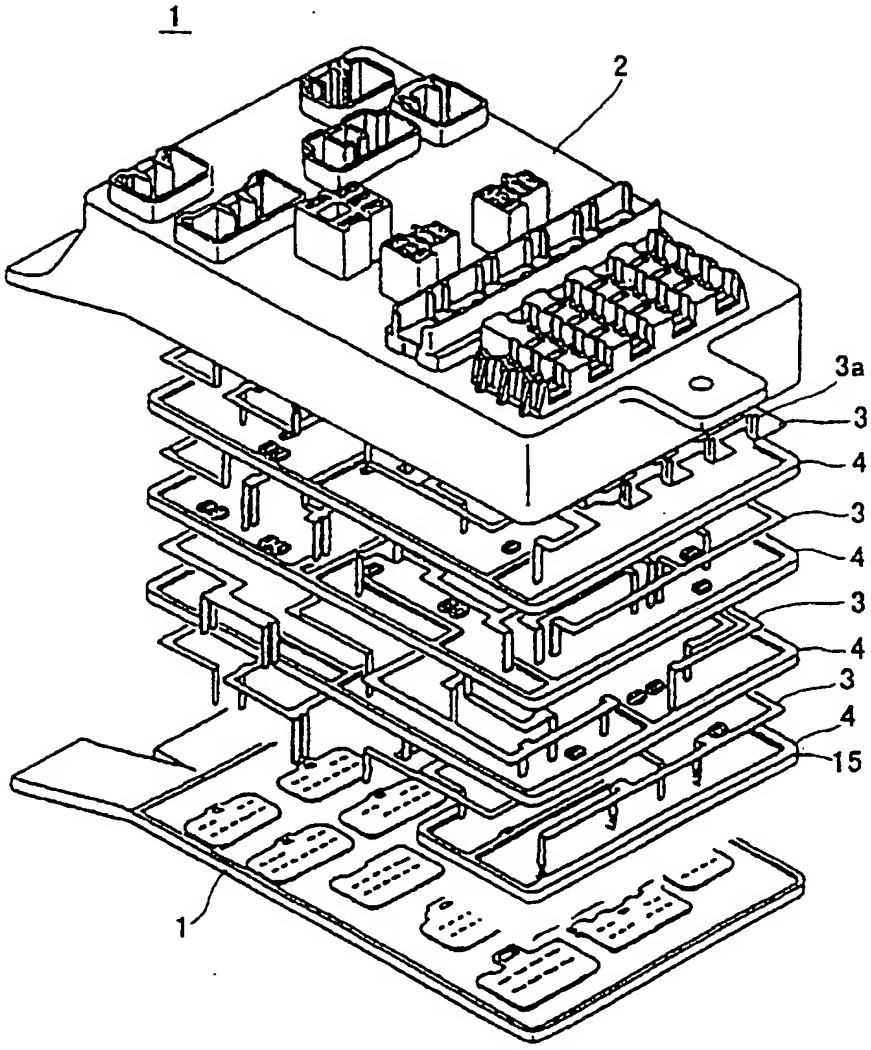

FIG. 2

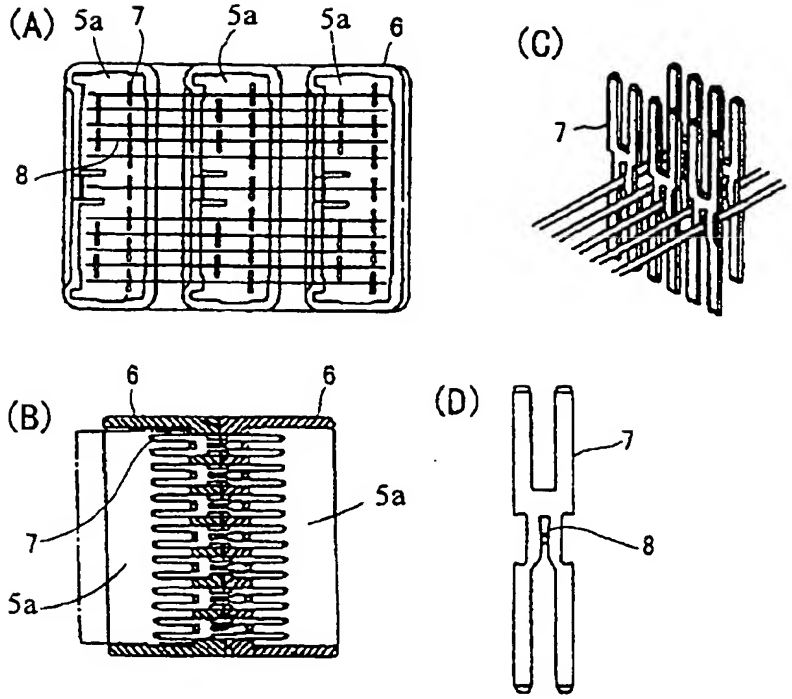


FIG. 3

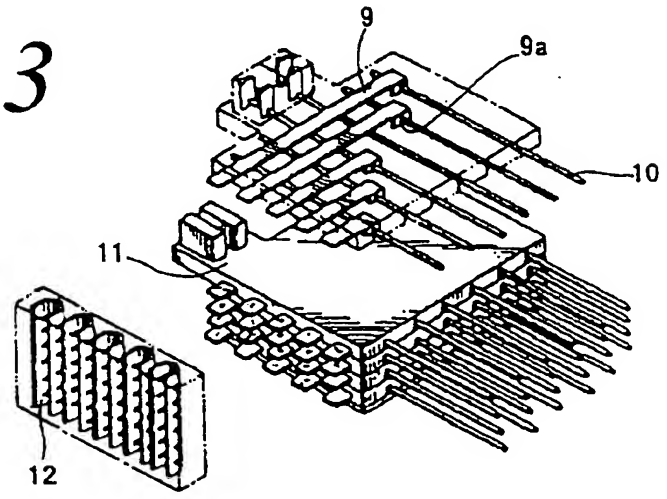

FIG. 4

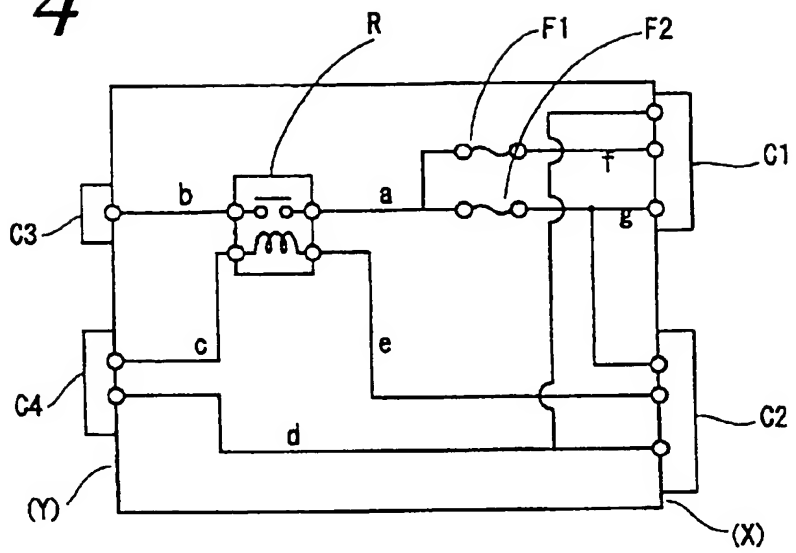


FIG. 5

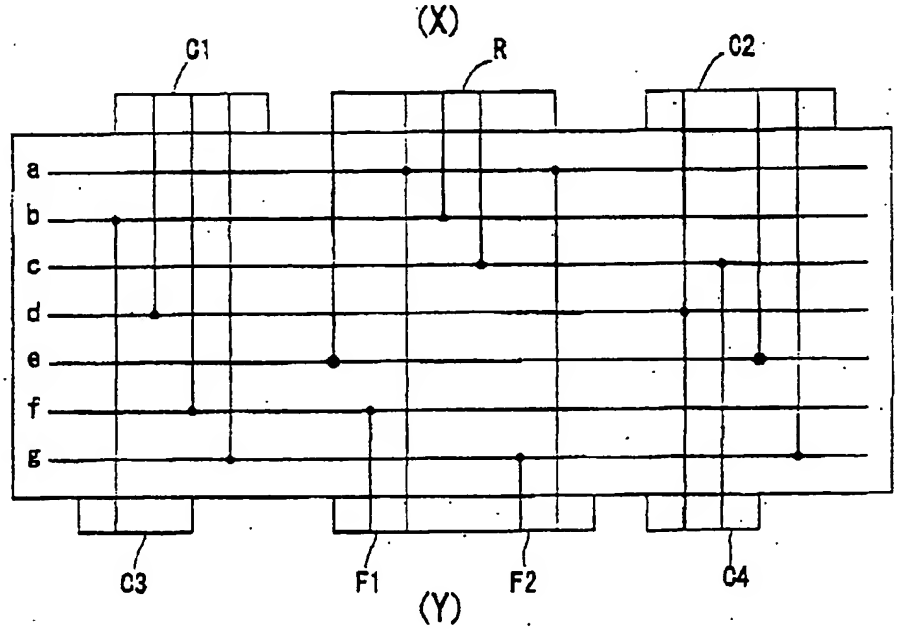

FIG. 6

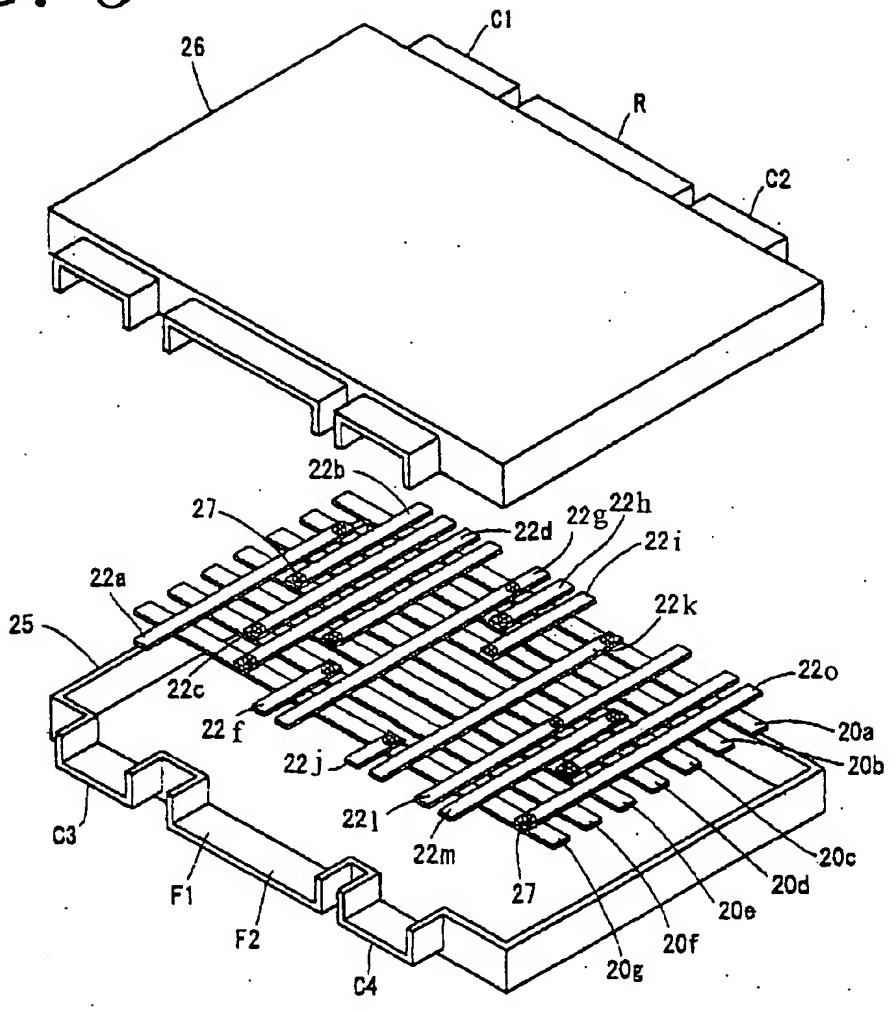
C1
26
R
C2
22b
27
22d
22g
22h
22i
22a
22k
25
22o
22c
20a
22f
20b
22j
C3
22l
22m
20c
27
20d
F1
20e
F2
20f
20g
C4

FIG. 7

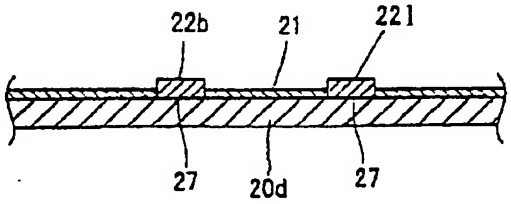
22b
21
22l
27
20d
27

FIG. 8

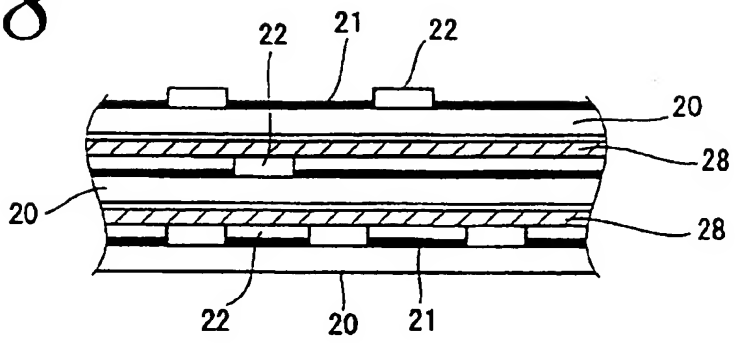


FIG. 9

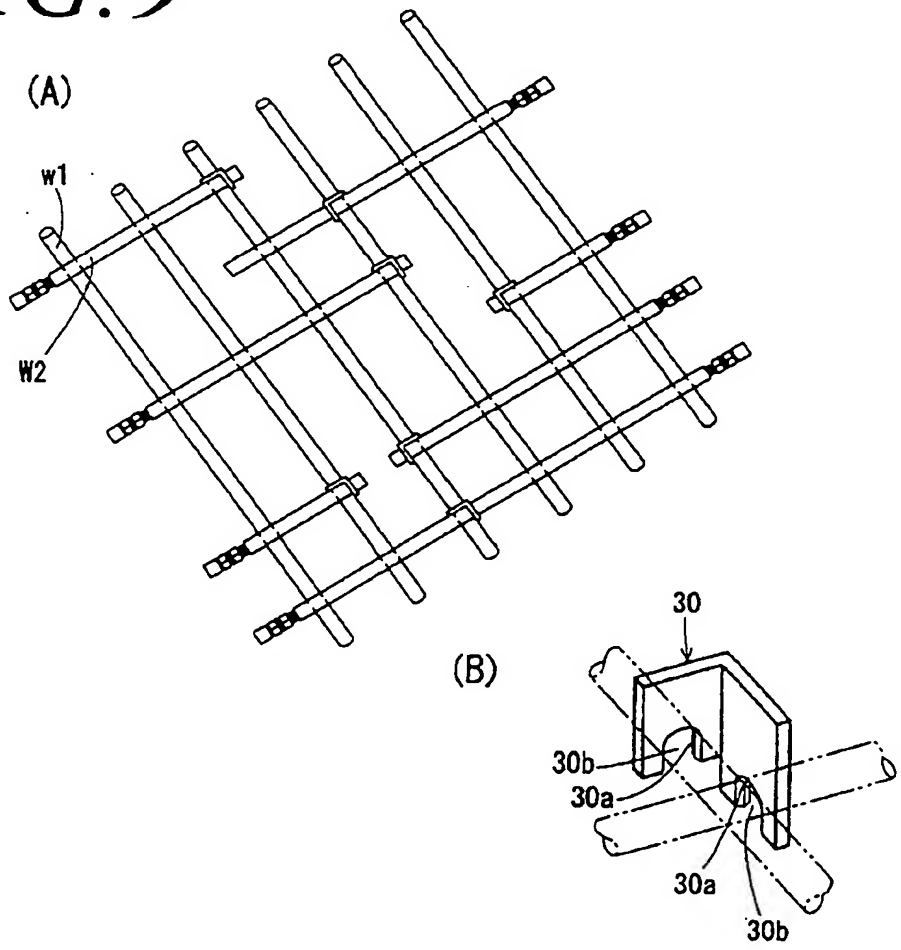

FIG. 10